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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/668,974	09/24/2003	Takashi Shimizu	065686-0158	1467

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EXAMINER	
JACOB, MARY C	

ART UNIT	PAPER NUMBER
2123	

DATE MAILED: 07/12/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/668,974	SHIMIZU ET AL.	
	Examiner	Art Unit	
	Mary C. Jacob	2123	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *24 September 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-12* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-4 and 7-10* is/are rejected.

7)☒ Claim(s) *5,6,11 and 12* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *24 September 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *2/23/06, 9/24/03*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

1. Claims 1-12 have been presented for examination.

Specification

2. The disclosure is objected to because of the following informalities. Appropriate correction is required.

3. Page 2, line 22 refers to "Gregory Scott and four others", it would be better if written, "Gregory Scott et al".

Claim Objections

4. Claims 1, 3-7, 9-12 are objected to because of the following informalities. Appropriate correction is required.

5. Claim 1, lines 16-17, "said approximate expression" would be better if written, "said corrected approximate expression".

6. Claims 3-5, 9-12 recite, "the reciprocal", would be better if written "a reciprocal".

7. Claims 5, 6, 10 and 11 recite, "dividing the range", would be better if written, "dividing a range".

8. Claim 7, lines 25-26 recite, "the diffusion length dependence", would be better if written, "a diffusion length dependence".

Claim Rejections - 35 USC § 112

9. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

10. Claims 3-7, 9-12 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

11. Claims 4, 6, 10 and 12 recite the term, "selectively applied". This term is unclear in meaning and the specification does not describe this term so that one would understand what is being claimed.

12. The term "plurality of ranges" in claims 4, 6, 10 and 12 is a relative term which renders the claim indefinite. The term "plurality of ranges" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention.

13. Claims 3- 6, 9-12 recite the limitation "the diffusion-length-dependent approximate expression". There is insufficient antecedent basis for this limitation in the claim.

14. Claim 7 recites the limitation "the correction values" in line 28. There is insufficient antecedent basis for this limitation in the claim.

Claim Rejections - 35 USC § 103

15. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and

the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

16. Claims 1, 2, 7 and 8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chung et al ("An Analytical Threshold-Voltage Model of Trench-Isolated MOS Devices with Nonuniformly Doped Substrates", IEEE Transactions on Electron Devices, Vol. 39, No. 3, March 1992) in view of Zhang et al (US Patent 6,618,837).

17. Chung et al teaches a trench isolated MOS device that is affected by the inverse narrow width effect, wherein as the channel width is reduced, there is a reduction of the threshold voltage (Introduction, paragraph 1). Chung et al teaches modeling a diffusion length dependent parameter, threshold voltage, for a trench isolated MOS device (page 615, column 1, paragraph 1) wherein it is necessary to add a correction factor to the threshold voltage calculation, therefore creating a corrected approximate expression for the threshold voltage (equation 7 and preceding 2 sentences; equation 8) that can be accurately determined from the 2D simulation of a real trench isolated MOS device (page 617, column 1, paragraph 1) and simulates the corrected transistor model over a

variation of widths (Figures 8-10). It is understood that the simulation would include the reading in of a circuit netlist and the calculation of changes of the current and voltage of the circuit to be simulated.

18. Chung et al does not expressly teach a correcting unit.

19. Zhang et al teaches a parameter correcting unit which creates corrected, or optimized, parameters for a transistor model to be used in SPICE simulations to reduce the difference between simulated and measured characterization by adjusting user selected model parameters, values of elements in the sub-circuit or combination of both (column 2, lines 30-36) which allow for the building of models that can predicate the variations in MOSFET's due to manufacturing processes (column 2, lines 13-15) by varying input parameters such as diffusion length dependent threshold voltage and mobility (column 15, line 58-column 16, line 30).

20. Chung et al and Zhang et al are analogous art since they are both directed to the modification of transistor model parameters for simulation.

21. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the corrected approximate expression for the diffusion length dependent parameter and simulation as taught by Chung et al to further include a correcting unit as taught by Zhang et al since the correction unit as taught by Zhang et al reduces the difference between simulated and measured characterizations (column 2, lines 30-36) and allow for the building of models that can predicate the variations in MOSFET's due to manufacturing processes (column 2, lines 13-15).

22. As to Claims 2 and 8, Chung et al and Zhang et al teach: wherein said diffusion-length-dependent parameter includes a threshold voltage parameter and a mobility parameter (Chung et al: page 615, column 1, paragraph 1; Zhang et al: column 15, line 58-column 16, line 30).

23. Claims 3, 4, 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Chung et al and Zhang et al as applied to claims 2 and 8 above, and further in view of Lin et al ("A Closed-Form Back-Gate-Bias Related Inverse Narrow-Channel Effect Model for Seep-Submicron VLSI CMOS Devices Using Shallow Trench Isolation", IEEE Transactions on Electron Devices, Vol. 47, No. 4, April 2000).

24. As to Claims 3, 4, 9 and 10, Chang et al as modified by Zhang et al teach: a diffusion length approximate expression for a threshold voltage parameter (Chang et al: equation 7 and preceding 2 sentences; equation 8).

25. Chang et al as modified by Zhang et al do not expressly teach wherein the diffusion-length-dependent approximate expression of said threshold voltage parameter is a polynomial of the reciprocal of diffusion length, wherein the diffusion-length-dependent approximate expression of said threshold voltage parameter includes a plurality of polynomials of the reciprocal of diffusion length, selectively applied to a plurality of ranges obtained by dividing the range of diffusion length values by one or more predetermined approximate critical diffusion length values.

26. Lin et al teaches an analytical inverse narrow channel effect threshold voltage model for shallow trench isolated CMOS devices that uses a conformal mapping

technique to simplify the two-dimensional analysis (Abstract, sentence 1). Lin et al teaches the diffusion-length-dependent approximate expression of said threshold voltage parameter is a polynomial of the reciprocal of diffusion length, wherein the diffusion-length-dependent approximate expression of said threshold voltage parameter includes a plurality of polynomials of the reciprocal of diffusion length, selectively applied to a plurality of ranges obtained by dividing the range of diffusion length values by one or more predetermined approximate critical diffusion length values (equation 13, V_{th}, C_1 and C_2; Figure 6 and description).

27. Chang et al as modified by Zhang et al and Lin et al are analogous art since they are both directed to the calculation of threshold voltage for a shallow trench isolated MOS device.

28. It would have been obvious to one of ordinary skill in the art at the time the invention was made to modify the diffusion length approximate expression for a threshold voltage parameter as taught by Chang et al and Zhang et al wherein the diffusion-length-dependent approximate expression of said threshold voltage parameter is a polynomial of the reciprocal of diffusion length, wherein the diffusion-length-dependent approximate expression of said threshold voltage parameter includes a plurality of polynomials of the reciprocal of diffusion length, selectively applied to a plurality of ranges obtained by dividing the range of diffusion length values by one or more predetermined approximate critical diffusion length values as taught by Lin et al since Lin et al teaches an analytical inverse narrow channel effect threshold voltage

model for shallow trench isolated CMOS devices that uses a conformal mapping technique to simplify the two-dimensional analysis (Abstract, sentence 1).

Allowable Subject Matter

29. Claims 5, 6, 11 and 12 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

30. The following is a statement of reasons for the indication of allowable subject matter:

While Chung et al teaches a corrected approximate expression regarding a diffusion length dependent parameter by calculating a correction value, wherein the diffusion-length-dependent approximate expression of said threshold voltage parameter includes a plurality of polynomials of the reciprocal of diffusion length, selectively applied to a plurality of ranges obtained by dividing the range of diffusion length values by one or more predetermined approximate critical diffusion length values, Zhang et al teaches a correction unit to optimize circuit parameters for the simulation of a transistor model including a threshold voltage parameter and a mobility parameter and Bianchi et al (see citation below) teaches accounting for mobility variations in shallow trench isolation CMOS devices by modifying the BSIM3 simulation model with a mobility model to account for mobility variations according to MOSFET geometry, neither of these

references taken alone or in combination with the prior art of record disclose wherein a diffusion-length-dependent approximate expression of a mobility parameter:

(claims 5 and 11) "is a polynomial of the reciprocal of diffusion length"

(claims 6 and 12) : "includes a plurality of polynomials of the reciprocal of diffusion length, selectively applied to a plurality of ranges obtained by dividing the range of diffusion length values by one or more predetermined approximate critical diffusion length values",

in combination with the remaining elements and features of the claimed invention. It is for these reasons that the applicant's invention defines over the prior art of record.

Conclusion

31. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

32. Bianchi et al ("Accurate Modeling of Trench Isolation Induced Mechanical Stress Effects on MOSFET Electrical Performance", International Electron Devices Meeting, IDEM '02, Digest, pages 117-120, December 8-11, 2002) teaches accounting for mobility variations in shallow trench isolation CMOS devices by modifying the BSIM3 simulation model with a mobility model to account for mobility variations according to MOSFET geometry.

33. Yamaguchi ("Field Dependent Mobility Model for Two-Dimensional Numerical Analysis of MOSFET's", IEEE Transactions on Electron Devices, Vol. ED-26, No. 7,

July, 1979) teaches a field-dependent mobility model that takes into account the gate field which induces carriers in the inversion layer and the drain field which transports carriers to the drain.

34. Bittner et al (U.S. Patent 6,314,390) teaches employing a stochastic search algorithm to determine model parameters for MOSFETS.

35. Kitamaru et al (U.S. Patent 6,909,976) teaches a threshold voltage model defined by using definite physical quantities and which comparatively easily provides a threshold voltage satisfactorily close to and actually measured threshold voltage.

36. Adams et al (U.S. Patent 6,649,429) teaches a method for measuring and monitoring the mechanical stress of a semiconductor device.

37. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Mary C. Jacob whose telephone number is 571-272-6249. The examiner can normally be reached on M-F 7AM-5PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Paul Rodriguez can be reached on 571-272-3753. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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Mary C. Jacob
Examiner
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MCJ
7/7/06

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7/10/06